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Mirage software automates design of optical metamaterials

Designers describe result, Mirage design aid does the rest

By ***Troy Rummler***

New software from Sandia lets users design science-fiction-like materials with the same efficiency that architects use when they draft building plans.

Sandia has created the first inverse-design software for optical metamaterials. That means users start by describing the result they want, and the software fills in the steps needed to get there. The modern design approach takes guesswork out of engineering as-yet theoretical technologies, such as ultracompact, high-performance cameras and cloaking armor that could make wearers invisible to detection.

Sandia uses the design aid, called Mirage, in its research and development programs and released a test version to select collaborators last year. Now, researchers working on government metamaterial projects can request a license at no cost.

Man-made optical metamaterials have been touted for more than a decade for their ability to manipulate light in extraordinary ways.

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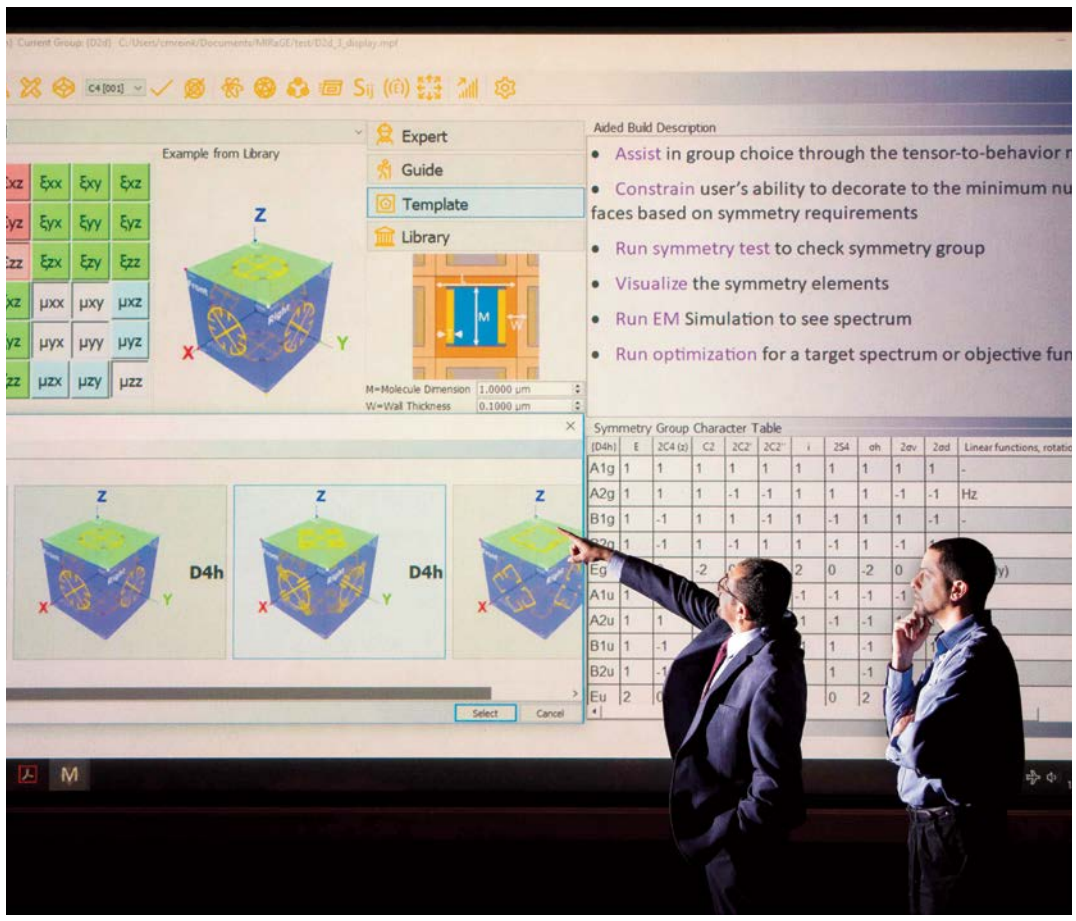
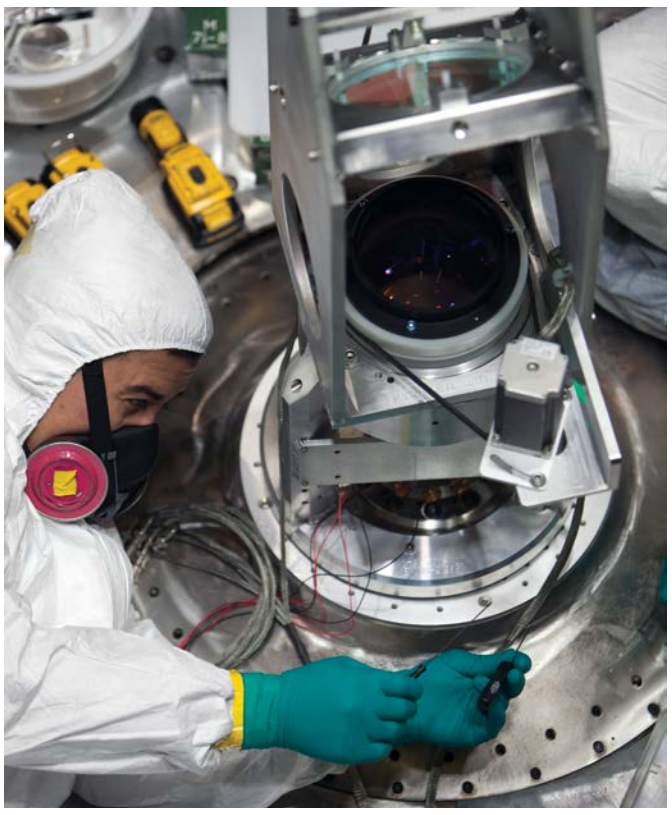


AUTOMATIC — Inverse-design software Mirage provides users a guide to making materials with advanced optical properties. Developers Ihab El-Kady (left) and Charles Reinke look over a sample Mirage screen.

Photo by Randy Montoya



FINE TUNING — Kenny Velasquez makes adjustments during the final installation of the hardware inside the chamber of the Z Line VISAR in preparation for the commissioning shot at Z Machine in December 2018.

Photo by Michael Jones

Device in Z machine measures power for nuclear fusion

By ***Neal Singer***

If you're chasing the elusive goal of nuclear fusion and think you need a bigger reactor to do the job, you first might want to know precisely how much input energy emerging from the wall plug is making it to the heart of your machine.

If somewhere during that journey you could reduce internal losses, you might not need a machine as big as you thought.

To better determine energy leaks at Sandia's powerful Z machine — where remarkable gains in fusion outputs have occurred over the last two and a half decades, including a tripling of output in 2018 — a joint team from Sandia and Lawrence Livermore national laboratories has installed an upgraded laser diagnostic system.

The quest to accurately understand how much power makes it into Z's fusion reaction has become more pressing as Z moves into producing the huge number of neutrons that now are only a factor of 40 below the milestone where energy output equals energy input, a desirable state known as scientific break-even. The Z machine's exceptionally large currents — about 26 megamperes — directly compress fusion fuel to the extreme conditions needed for fusion reactions to occur.

Laboratory fusion reactions — the joining of the nuclei of atoms — have both civilian and military purposes. Data used in supercomputer simulations offer information about nuclear weapons without underground tests, an environmental, financial and political plus. The more powerful the reaction, the better the data.

— CONTINUED ON PAGE 3

Annual Labs Accomplishments in news racks near you

The annual Labs Accomplishments magazine is now available on Lab News racks throughout the Laboratories or from the communications team in the IPOC building. The publication recognizes some of Sandia's best work during 2018, as submitted by center offices and selected by division offices. The publication highlights critical milestones in key mission areas, scientific breakthroughs reached via Laboratory Directed Research and Development and valuable advances in mission support.

As Labs Director Steve Younger notes in his introduction, "Every Sandian plays a role in these accomplishments."

The Labs' work to solve the nation's toughest national security challenges is needed now more than ever, Steve writes.

"The scope of our capabilities makes us invaluable," he adds, encouraging the community, families and friends to "enjoy this look at the outstanding work done by the people of Sandia. I promise it will be time well spent."

The publication is also available online.

TEACHING TOOL — Mirage developers Charles Reinke (left) and Ihab El-Kady think their software could lower the experience level and patience needed to engineer promising optical metamaterials. **Photo by Randy Montoya**

Mirage software

CONTINUED FROM PAGE 1

In theory, imaging satellites and interstellar telescopes could be dramatically smaller with metamaterial lenses one hundred times thinner than conventional ones. Or, the technology could someday lead to cloaking materials that deflect light around them, rendering objects impossible to see.

Mirage simplifies and automates the design process for materials needed to make such technologies a reality.

Mirage takes guesswork out of design

The field of optical metamaterials so far has struggled to deliver on all its perceived promise of revolutionizing optics. One difficulty for engineers has been that metamaterials are made of tiny building blocks, called meta-atoms, which can be designed in countless variations. A certain shape, collectively, might bend light. Change that shape, the size, the spacing or the material — and that might amplify or diminish the effect, or cause something entirely different to happen, like twist the light one direction or another or change its intensity or color.

"Predicting what the bulk 'homogenized' properties will be has been very hard to determine until now," said Mike Fiddy, a program manager in the Defense Advanced Research Projects Agency, which funded the software's development.

Other software can simulate what meta-atoms will do to light, but that only allows researchers to use intuition to experiment with different designs until they stumble upon or tediously work out the behavior they want.

Despite the challenge, some researchers successfully have created imaginative metamaterial devices. Sandia invented a device that converts heat to electricity, potentially for more fuel-efficient engines, as well as a light-mixing technology that could lead to a new, changeable, multicolored light source. Such a source could accelerate all kinds of research, from archeology to biomedicine.

But on the whole, said Sandia scientist Ihab El-Kady, the metamaterial enterprise has needed a boost.

"We cannot possibly solve this problem by trial and error," said Ihab, who conceived Mirage. "Instead, we could do the opposite. We could say: 'Here is the behavior I want. Now tell me what the metamaterial looks like.'"

No tool used this inverse-design approach. So, Ihab and his team at Sandia's National Security Photonics Center built one.

User-friendly instructions to exploit 100-plus templates

Mirage lets users start by telling the software the optical property they want — how their metamaterial needs to interact with light — and their starting materials. Mirage generates designs that match those criteria from a library of more than 100 templates. Or, users can draw their own designs, and the program will check them for errors.

"A more systematic approach for designing metamaterials should greatly accelerate their adoption in various application areas," eliminating more commonly used, intuition-based approaches, Fiddy said.

DARPA featured Mirage as a premier technology at the agency's 60th Anniversary Symposium in Fort Washington, Maryland, showcasing its far-reaching uses.

"Mirage is an all-in-one tool," Ihab said. "Not only does it tell you what the metamaterial looks like, it allows you to explore various configurations, simulate the system, validate the chosen behavior, visualize its response and optimize its functionality within your fabrication constraints."

Software refines powerful ideas

On top of that, Mirage is useful because it includes algorithms that help researchers get the best performance from their inventions, said Sandia senior scientist Igal Brener, who uses the software in his metamaterial research.

Igal's team previously created a material that can mix two lasers to produce 11 colors at once, including infrared and ultraviolet light. The technology could be developed into tunable lasers that replace single-color ones.

But some of those colors are too dim to be useful, so he's exploring ways to brighten the output. Other software packages Igal has used include simple optimization algorithms. However, to use more advanced algorithms he must supplement those packages with his own coding. Not so with Mirage.

"Optimization techniques come in many different flavors," he said. "Mirage is the only software package I know of that has the complex optimization techniques I need built in."

If the initial launch is successful, Sandia plans to develop a second version of Mirage, tentatively called Mirage Elite, that would introduce a surge forward in optimization by automatically morphing meta-atoms into bizarre and outlandish shapes in the hunt for undiscovered behaviors.

Researchers interested in a copy of Mirage are invited to contact Sandia for more information. To be eligible for a free copy, recipients must have a valid research contract with the U.S. government. Mirage runs on Windows and can be configured to operate on laptop, desktop and multicore machines.

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LAB NEWS ONLINE: sandia.gov/LabNews

David Chacon honored with Legion of Merit

Photo by Randy Montoya

David Chacon, who works in Sandia's information technology audits group, has been awarded the Department of Defense Legion of Merit for exceptionally meritorious conduct in the performance of outstanding services and achievements during his tenure in the U.S. Army.

The Legion of Merit is issued to members of the seven U.S. uniformed services as well as to military and political figures of foreign governments. The award ranks just below the Silver Star and above the Distinguished Flying Cross in the list of medals. It is one of only two decorations to be issued as neck wear. The other is the Congressional Medal of Honor.

Col. Chacon retired from the New Mexico Army National Guard in May 2018 after serving more than 33 years in the Air and Army National Guard as an enlisted soldier and officer. His final duty position was brigade commander.

HANDS ON AGAINST RARE DISEASES — Melissa Kleinsteuber (left) and Mark Maes sign a banner to show solidarity for colleagues living with rare diseases. Banner signing and a walk/run event were held at both campuses for Rare Disease Day. **Photo by Norm Johnson**

Sandia walks for Rare Disease Day

By ***Jason Tarin***

The Sandia workforce last month came outside in force during a rare rainstorm for the inaugural Rare Disease Day at the California campus, and into the typical spring winds for New Mexico's third annual celebration of the same event. More than 100 staff took part between the two sites.

Rare Disease Day, hosted by Sandia's Disability Awareness Committee, supports individuals with rare diseases and creates awareness among the public and policymakers.

There are more than 7,000 rare diseases. There's no cure for the majority and many go undiagnosed. About one in 20 individuals worldwide will live with a rare disease at some point in their lifetime.

"It was fantastic to see the California community come out to support Rare Disease Day," said Kelly Nykodym, who finished first among females in the rain-soaked run/walk competition. "I had a great time braving the rain with my coworkers to raise awareness and participate."

California committee chair Dalton Bradley was pleased with the event as a positive start to bringing disability awareness to Sandia/California.

"This initiative is so important because awareness of diversity and the inclusion of everyone's thoughts and ideas are vital to the success of our community," Dalton said. "People who live with disabilities and diseases are forced to look at life in a different way and therefore can bring insights that are unique and nearly impossible to discover otherwise. My goal is for everyone to feel comfortable bringing their diverse life experiences to the table."

Participants signed the Rare Disease Day banner and walked or ran in solidarity while carrying informational signs about a rare disease.

"Many Sandians came up to share stories about how a rare disease has impacted their lives," said Victoria Newton, who organized the New Mexico event and serves as vice chair of the Disability Awareness Committee. "This event was an excellent display of our workforce embracing differences and celebrating community."

The committee is one of several employee resource groups that support the Labs' goal of promoting a welcoming, diverse, respectful and inclusive environment that encourages growth, development and full contributions from all members of the workforce. The groups promote cultural awareness within the Labs, participate in outreach activities that build relationships within Sandia's local communities and work with management to identify and address concerns.

For those who wish to get involved, information about all resource groups is available online.

New device in Z machine

CONTINUED FROM PAGE 1

And, over the longer term, the vision of achieving an extraordinarily high-yield, stable and relatively clean energy source is the ambition of many researchers in the fusion field.

A little help from our lasers

The laser diagnostic system that Sandia developed to help achieve these improvements was originally called VISAR, for Velocity Interferometer System for Any Reflector. VISAR takes information about available power gathered from an area the size of a pencil point.

The new system, called Line VISAR, was developed later at Lawrence Livermore. It analyzes information gleaned within the larger scope made available through a line, instead of a point, source.

Both innovations bounce a laser beam off a moving target at the center of Z. But there's a big difference between the two techniques.

VISAR uses a fiber cable to send a laser pulse from a stable outside location to the center of the machine. There, the pulse is reflected from a point on a piece of metal about the size of a dime called a flyer plate. The flyer plate, acting like a mirror, bounces the laser signal back along the cable. But because the flyer plate is propelled forward by Z's huge electromagnetic pulse by a distance of roughly a millimeter in a few hundred nanoseconds, the returning pulse is slightly out of phase with the input version.

Measuring the phase difference between the two waves determines the velocity achieved by the flyer plate in that period. That velocity, combined mathematically with the mass of the flyer plate, is then used to estimate how much energy has driven the plate. Because the plate sits at the heart of the machine, this figure is nearly identical to the energy causing fusion reactions at the center of the machine. This observation was the objective of VISAR.

But the point target could not account for distortions in the flyer plate itself caused by the enormous pressures created by the electromagnetic field driving its motion.

Lawrence Livermore's improvement to the device, now installed at Z, was to send a laser beam along an optical beam path instead of a fiber cable. Passing through lenses and bouncing off mirrors, Line VISAR returns a visual picture of the pulse hitting the entire flyer plate, rather than returning a single electrical signal from a single point on the flyer plate.

Researchers study the contrast between the phase-changed Line VISAR picture and an unchanged reference picture and then slice along a line so that an ultra-high-speed movie with a reduced but workable amount of data can be recorded. By analyzing the movie, which shows the expansion and deformation of the flyer plate, researchers uncover a truer picture of the amount of energy available at the heart of the machine.

"Because you have spatial resolution, it tells you more precisely where current loss occurs," said Clayton Myers, who's in charge of experiments at Z using Line VISAR.

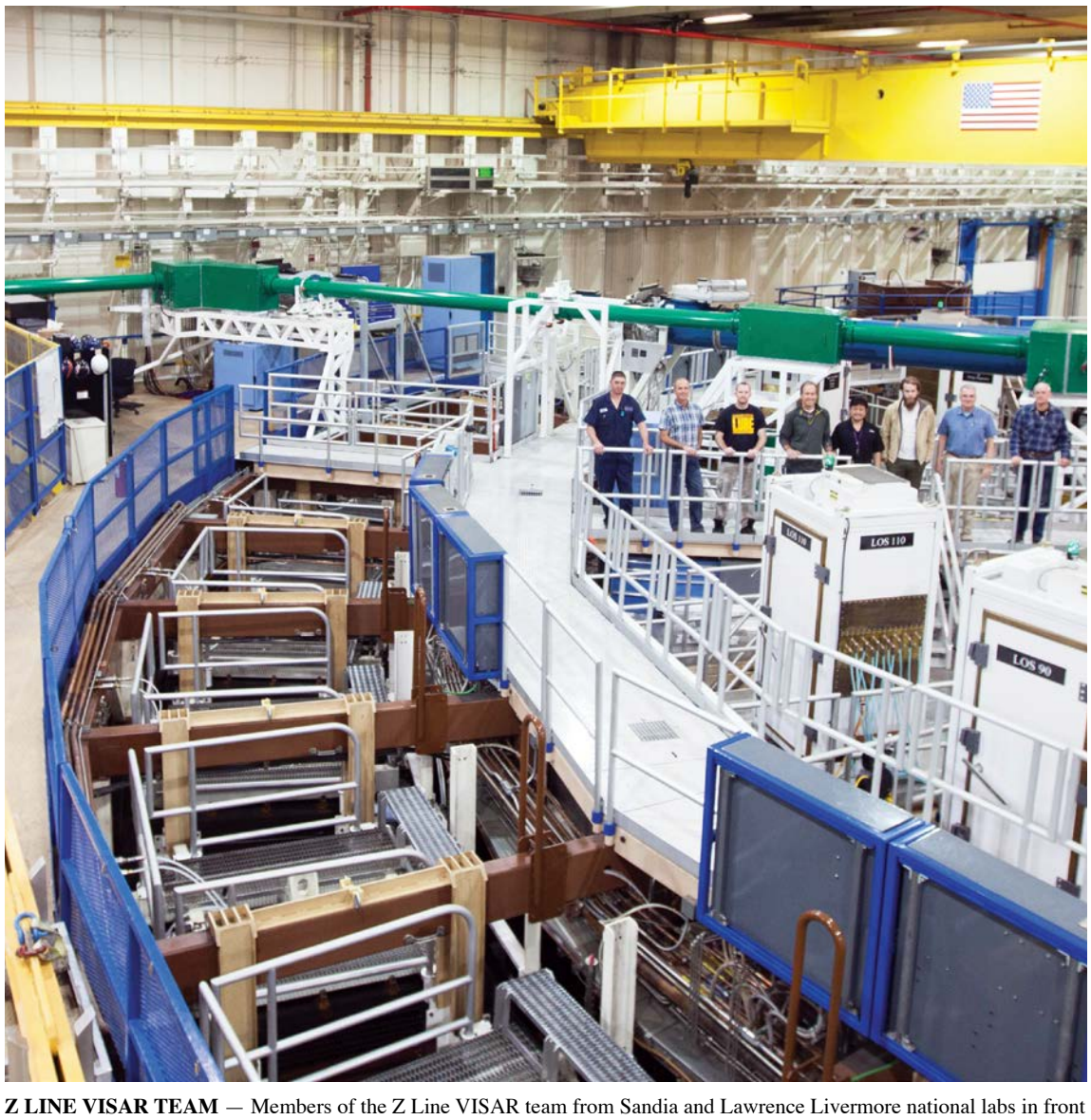
Sandia and Lawrence Livermore technicians modified the Line VISAR to work at Z, where everything busily happens at the heart of a machine that shakes coffee cups in buildings several hundred feet away when it fires, compared with the relative calm of the National Ignition Facility at Lawrence Livermore, where banks of lasers sit removed from the otherwise tranquil sphere in which firings take place.

"The Sandia team was tasked with integrating the various Line VISAR components into the existing infrastructure of the Z machine," Clayton said. "This meant, among other things, engineering a 50-meter beam transport system that provided a buffer between the instrument and its Z target."

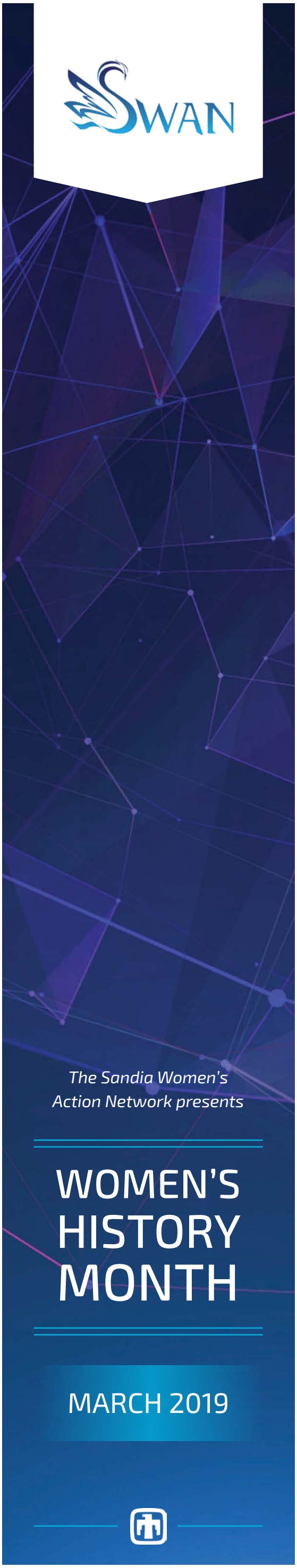
Nevertheless, the last optic of Line VISAR at Z must be replaced for every shot, because it faces near-instant destruction from the energy delivered as Z fires.

How does the new detection system work?

"Wonderfully," said Clayton. "I can hardly believe the precision of the data we're getting."



Z LINE VISAR TEAM — Members of the Z Line VISAR team from Sandia and Lawrence Livermore national labs in front of the completed Z Line VISAR beam transport system (green) on Nov. 10, 2018. **Photo by Michael Jones**



Leveling the playing field

By **Stephanie Holinka**

As part of Women's History Month, the Sandia Women's Action Network (SWAN) co-hosted a discussion of Stanford professor Shelley Correll's video, "Leveling the Playing Field," about research that documents how systemic bias impairs the career trajectories of women.

In the video, Correll describes how earlier, rapid progress in the narrowing of gender inequality in the workplace has stalled since the 1990s, which she attributes partially to persistent and systemic flaws in how women and men are perceived and evaluated in the workplace.

Correll is director of Stanford's VMware Women's Leadership Innovation Lab and the Clayman Institute for Gender Research. She studies gender, workplace dynamics and organizational culture.

The discussion was co-sponsored by Sandia Inclusion, Diversity, Equal Opportunity and Affirmative Action.

Gender stereotyping leads both to more positive evaluations of men in the workplace, and more negative evaluations of women, Correll said. Often the importance of and reliance upon various criteria will change mid-decision to support gender bias in professional settings.

Correll also noted that women are less likely to have influence in work groups, and are less likely to get credit for their ideas.

"Our solution must break the solution of using stereotypes as a cognitive shortcut," she said.

During the discussion, SWAN co-chair Lucille Shaw encouraged Sandia participants to share stories about ways in which their work trajectories were impacted by bias and instances where their contributions were ignored or attributed to male team members.

Labs Director Steve Younger also emphasized to attendees that representation of women at all levels is of Labs-wide importance, and has the attention of senior leadership.

Correll mentioned that one way to increase participation of women in a field is to decide on specific criteria in advance of a hiring or promotion decision, and then scrutinize the criteria used when the decision is made, recognizing that barriers such as specific experience can perpetuate past bias against women.

For example, Correll said Carnegie Mellon University increased the representation of women in its computer science undergraduate major from 7 to 42% in five years by removing computing experience as a major admission criterion. University officials found that men were more likely to show up with experience, Correll said, but they ultimately learned that experience didn't affect the quality of the scientist.

> ***"Our solution must break the solution of using stereotypes as a cognitive shortcut."***
>
> — Shelley Correll

Correll recommended mitigating cognitive bias through transparent decision-making processes and advance agreement on specific criteria. She also said that vouching for the competence of leaders in an organization encourages employees to recognize the competence and authority of women.

In conclusion, Correll challenged viewers to create workplaces where men and women can thrive.

"By removing the errors in decision making that stereotypes produce, organizations will be able to more fully harness the full range of talent in today's workforce," Correll said.

Networking about women

NETWORKING ABOUT WOMEN — Sandia's supplier diversity team held an open house for women-owned small businesses last month at the Lobo Rainforest Building in downtown Albuquerque. As part of the Women's History Month event, a panel spoke to business owners about networking and resources available to women whose businesses contract with government agencies. Panelists (left to right) were Susan D. Swafford, an Air Force veteran and founder of Core Advantage; Arthur Humphries of the New Mexico Procurement Technical Assistance Center; Patricia Brown, a Sandia supplier diversity advocate; and Joshua Baca with the U.S. Small Business Administration. **Photo by Nicholas Kerekes**

Blythe Clark, SWAN co-chair **Photos by Lonnie Anderson**

Male advocates moving from awareness to action

By ***Myles Copeland***

Max Dubroff spent much of his military career supervised by trailblazing women.

"In my time in the Air Force, I had a wonderful opportunity, four times, to serve under commanders who were 'first women,' that is, the first time ever in history that a woman commanded that type of unit," said Max, now a Sandia human resources business partner.

"They did a wonderful job, they deserved the job, but they didn't get there by just being available," he said. "It was a leadership focus. It was their commanders over them that chose them and set them up — over the years of their career — set them up for those jobs, to excel."

Max delivered his remarks to a crowd of more than 100 people, roughly an equal mix of men and women, for a discussion of, "Stepping Up as a Male Advocate for Women." Organized by the Sandia Women's Action Network, the Women's History Month panel of male Sandia staff sought to inspire actions towards a culture free of bias for all Sandians.

SWAN co-chairs Lucille Shaw and Blythe Clark led the panelists through a discussion of Rania Anderson's "WE: Men, Women and the Decisive Formula for Winning at Work." Dubroff was joined on the panel by Labs Director Steve Younger; directors Scott Holswade, advanced systems, and Tim Knewitz, business management; Cole Yarrington, a manager in materials; and Simon Cordero, a team lead in communications.

"One of the things the book talks about is that awareness, as a first step, is not enough," said Cole. "Corporations have historically tended to focus on awareness, and awareness is sort of where it stops."

Steve indicated a no-nonsense focus on changing the Labs' workforce demographics.

"I want to see changes in the numbers," said Steve. "I want to see the needles move for both minorities and women."

"We're entering a time of unprecedented geopolitical complexity," said Steve, describing the need for this change. "The worst thing that we can do for the country is have a group of people who look just like me decide what the future of the world is going to be and what we need to do to defend America in that world."

"It's a much more diverse world," Steve said. "People think differently than we do. So, it behooves us, in carrying out our mission, to reach the widest selection of approaches and opinions and perspectives that we can."

Steve Girrens, associate labs director for Nuclear Deterrence and executive champion for SWAN, was one of several speakers who said the book made them aware of everyday actions they could take to create a better work environment.

Lucille Shaw, SWAN co-chair

"I realized I could be more mindful of the time of day I schedule meetings — a simple thing like that — to better allow women and men to pick up their young children from school or daycare," he said.

The book left Max considering what he could do next.

"I read the book and I was super excited because I kept going, 'Yep. I do that. Yep. Done that,' like I was making some sort of a checklist," said Max. "I missed the point (but) I figured it out, that this is not about what I've done, it's about what I'm going to do."

Working together for gender equity

By ***Blythe Clark and Lucille Shaw, SWAN co-chairs***

The topic of gender bias has received a lot of attention in recent years as a neurologically driven impulse that can create an uneven playing field in the workplace.

Experts know stereotypes are formed through upbringing, societal influence and life experiences, as opposed to deliberate choices.

Still, the topic of gender bias too often is perceived as a matter of blame. As a result, some folks flee at the very mention of gender bias. Even those who are eager to jump in may not know where to start. SWAN often hears, "OK. I'm bought in. Now what?"

While gender bias is clearly not a problem for men alone to fix, their engagement is critical. In a recent survey in the book, "WE: Men, Women and the Decisive Formula for Winning at Work," 96% of respondents reported progress in company gender-diversity initiatives when men were involved, compared to 30% when men are not.

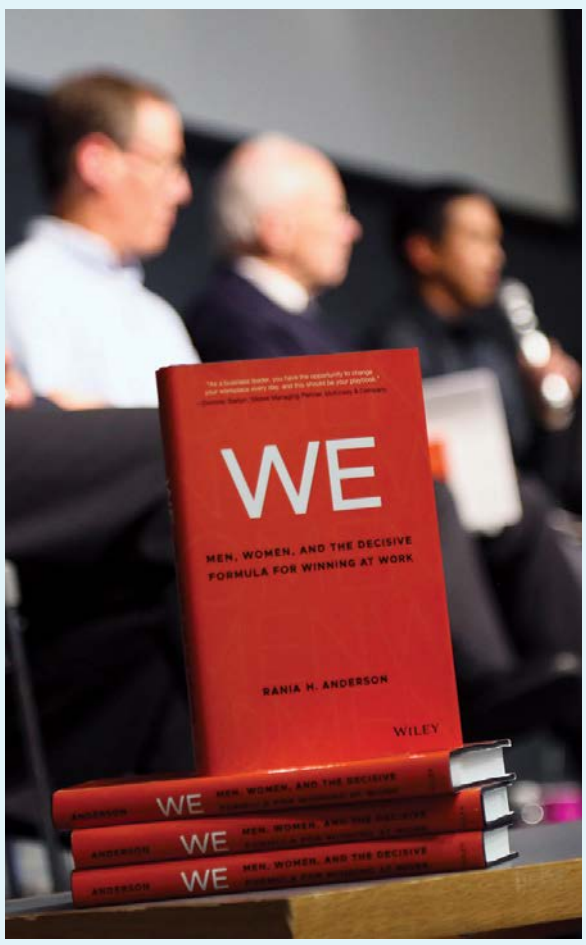
We are accustomed to hearing about the impacts of gender bias through the lens of women, but SWAN felt it important to open a dialogue on addressing gender bias and gender parity with men — men who see themselves as advocates of gender equality, both for personal reasons and to support Sandia's business goals.

The panel discussion was not to make a case for why women are valuable in leadership. As the book states, "We wouldn't ask for a business case for men serving in leadership positions."

Nor are we suggesting that women can't be successful on their own merit without the advocacy of men. The book strives to clearly articulate the value of inclusion and offer simple, tangible solutions for people to apply.

At its core, the discussion was a call to action for all of us.

We can't reverse the effects of gender bias and other implicit biases simply by being aware. It takes thoughtful assessment of our work environment and everyday actions to ensure we are including, respecting and valuing the contributions of everyone.



PLAYBOOK FOR CHANGE —A panel drawn from across the Labs discussed Rania Anderson's book, WE, during a Women's History Month event hosted by the Sandia Women's Action Network.

Sandia's Tidwell talks to Congress about water-energy issues

POST-HEARING POSE — Vince Tidwell (far left) with U.S. Rep. Conor Lamb, D-PA (second from left), after Vince's recent testimony to Congress on water issues. **Photo courtesy of Sandia Government Relations**

By ***Michael Padilla***

Vince Tidwell of Sandia's water program testified last month on DOE's research and development into the connections between energy and water before the U.S. House of Representatives Committee on Science, Space and Technology.

"This energy-water nexus is a complex system that my colleagues and I in the research community have sought to understand," Vince said. "We in turn use this knowledge to develop advanced technologies and tools to support water and energy policymakers and planners. While our focus today is on the nexus of energy and water, we must not lose sight that the connections go far beyond. Energy and water are tightly coupled to land, food and agriculture."

Sandia's energy-water nexus research program seeks to develop science-based engineering solutions to safeguard resilient and sustainable energy-water systems, in the interest of national and global security.

Vince focused on three points:

- Challenges and opportunities related to the energy-water nexus are expressed differently in different regions.
- Integrated planning improves coordination between water, energy and environmental managers jointly addressing issues of resource sustainability, waste management and supply-chain security.
- By harnessing the research and development capabilities of the national labs, academia, private industry and federal agencies, the U.S. can develop advanced water treatment technologies that make new sources of water cost competitive, thereby reducing reliance on fresh water.

Research into the energy-water nexus is more than simply avoiding unintended consequences of a complexly coupled system, Vince told the subcommittee.

"Rather, we have the opportunity to completely reimagine our energy and water future," he said. "We are striving for an energy system that is not dependent on fresh water in our water-limited regions. Likewise, we envision a future where non-traditional water sources like brackish water, seawater, produced water and wastewater can be treated at cost-competitive levels. Such changes will have impact well beyond the energy and water sectors, influencing our economy and national security."

During the hearing, both Conor Lamb, D-PA, who chairs the committee, and the ranking member, Randy Weber, R-TX, referred to Sandia's leadership in studying the energy-water nexus and commended Vince and his colleagues for helping stakeholders understand the trade-offs of policy and planning decisions.

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SUITCASE, American Tourister, large, black, very good condition, $35; round card table, $5. Hitchcock, 299-2581.

MEN'S CLOTHING, nice, gently used, everything in neat condition: cashmere coats, blazers, & sport coats, size: medium. Hill, 505-610-2436.

DINING SET, Drexel, vintage: table w/2 leaves, 6 padded cane back chairs, buffet, $750. Schueler, 505-331-8502.

WOOD DESK, big, glass top, tall chair, 40 yrs. old, ~5'W x 3'D x 30"T. Clem, 505-281-1119.

CAT LITTER BOX, 2, large, Omega Paw Roll N' Clean Cat, brand new, $26.50 ea. Burnett, 505-974-5653.

TELESCOPE, Orion 130ST Newtonian, used, w/tracking motor drive upgrade, paid >$400, asking $300 OBO. Garcia, 505-270-5855.

INSTANT POT, 8-qt., 9-in-1 pressure cooker, new-in-box, retails <$140, asking $80. Smith, 505-917-7591, call or text.

TABLE, 50-in. round, metal, cream colored, w/frosted glass top, w/4 cream-colored chairs, $75. Taylor, 505-205-5172.

EXERCISE BIKE, Nordictrack recumbent, Commercial VR25, 7-in. touchscreen, 26 resist levels, iFit, new, $900. Miller, 505-514-8744.

SEWING MACHINE, Bernina 810, mint condition, $350. Stubblefield, 263-3468.

'16-'19 TACOMA OEM ITEMS: running board, $240; exhaust T, $50; trailer mount, ball, pin, $50. Gonzalez, 505-480-4889.

MATTRESS, king size, memory foam, good condition, $150. Briggs, 505-280-3934.

QUEEN ANNE CHAIR, high-back, melon color, $100; roll-top desk, $300; photos available. Brewster, 238-4704, ask for Julie.

JOHN MELLENCAMP TICKETS, 3, April 30, 8 p.m., Kiva Auditorium, sec. 1, row F, seats, 7, 8 & 9, $289. Smith, 505-463-0911, texts preferred.

BILLIARD TABLE, Connelly, 8-ft., w/all accessories, must be disassembled to move, $1,500. Dye, 505-270-5228, jndye@msn.com.

UPRIGHT PIANO, Baldwin, 1985, pecan, $1,000. Valdez, 505-550-1993.

VACUUM CLEANER, Kirby Sentria II 2 G10D, w/ Sentria carpet shampooer, like new, used a couple times, w/bags, $325. O'Grady, 720-587-9857.

WATERBED, super-single, oak frame w/6 drawers, bookshelf, w/sheets, excellent condition, $250 OBO. Duggan, 505-977-5957.

TRANSPORTATION

'03 MERCURY GRAND MARQUIS, leather, power, AM/FM/CD, 1 owner, 133K miles, new tires & battery, paint fading, $3,300. Champion, 299-0163.

'03 MAZDA PROTÉGÉ ES, sedan, good AC, PW, sunroof, new tires, $2,000 OBO; '71/'72 Honda N600 sedans, project or spare parts, $3,000/pair. Clements, 806-683-1367.

'01 TOYOTA TACOMA SR5 TRD, off road, 4x4, extra cab, white, 2nd owner, great shape, well maintained, lifted, 147K miles, $7,500. McNellis, 505-507-8195.

'15 VOLKSWAGEN GTI AUTOBAHN, performance pack, 4-dr. AT, white, 39K miles, showroom condition, $18,900. Baca, 505-322-8999.

'15 HYUNDAI SANTA FE SPORT, FWD, 4-cyl., AT, pearl white, 74.6K miles, great condition, $13,750. Sanchez, 505-974-0874.

'04 NISSAN ALTIMA 3.5 SE, pearl white, 122.6K miles, good condition, w/last 10 yrs. of dealer maintenance, $2,400 OBO. Corley, 505-681-3705.

'03 LEXUS GS300, Straight 6 engine, white, leather, sun roof, dealership maintained, 126K miles, $4,200. Medina, 505-238-8767.

'01 FORD RANGER, supercab, 3.0L, 6-cyl., 5-spd. manual, saddle box & rack, 211K miles, new tires, battery & starter, $2,900. Buser, 362-3979, call or text.

'00 FORD MUSTANG GT, V8, 4.6L, http://tinyurl.com/y6pqxnlc. St. John, 505-977-1198.

'86 F250, regular cab, flat bed, 76,250 miles, rebuilt engine, Tommy lift, adjustable metal fence sides, $4,000 OBO. Brunacini, 505-883-2557.

'88 SAAB 900 TURBO SPG, rare black w/tan leather, great condition, see Craigslist #6847981507. Miller, 934-6718.

'10 TOYOTA 4 RUNNER LIMITED, 4x4, heated seats, 106.6K miles, very clean, $21,900; '12 Ford Escape Limited, flex fuel, AWD, 74,448 miles, $10,450. Miller, colo74kid@gmail.com.

'05 CORVETTE, blue w/ tan interior, 64K miles, excellent condition, VIN report & photos on request, $21,000. Cocain, 505-550-8484.

'71 MERCURY COUGAR XR7, very good condition, as is, rebuilt carb, transmission, refurbished bucket seats, new vinyl top, $12,000 OBO. Davison, sogwap@netzero.com.

RECREATION

PONTOON FISHING BOAT, lightweight, inflatable, 9-ft., storage pockets, minimally used, excellent condition, $175. Montoya, 342-0043.

'14 JAYCO GREYHAWK FS-31, E-450, 32-ft., 2 pullouts, extended warrantees available, 26.5K miles, $67,000. West, 292-3196.

'10 BMW F650GS, dual sport, 800 cc, antilock brakes, extras, excellent condition, >20K miles, $5,500, open to trades. Amon, 505-280-2167.

'11 BMW F650GS, 800 cc, Lava Orange, antilock brakes, only 600 miles, $4,500. Fondren, 463-5572.

YOUTH MOUNTAIN BIKE, specialized Hot Rock, 24-in., black & white, great shape, $100. Lopez, 505-206-2011.

'16 LANCE 1995 TRAVEL TRAILER, 24-ft., slide out, new tires, many extras, sleeps 4, immaculate, $26,950 OBO. Hahn, 505-822-1342.

'13 KZ SPREE TRAVEL TRAILER, 26-ft., see on Craigslist #6858215308, $16,300. Martinez, 505-259-3426.

REAL ESTATE

3-BDR. HOME, 2-1/2 baths, 1,670-sq. ft., 5121 Noreen Drive NE, 87111, MLS# 931444, $256,000. Giar, ryangiar@gmail.com.

3-BDR. HOME, 1 bath, ~1,238-sq. ft., renovated, 11603 Summer NE (Juan Tabo & Constitution), description on Zillow.com, $181,000 OBO. Christensen, irunia@hotmail.com.

3-BDR. HOME, 2-1/2 baths, walking distance to Eubank, Willow Wood, see forsalebyowner.com, FSBO $275,000. Dinge, 505-818-8933.

2-MASTER BDR. TOWN HOUSE, luxury, possibly 3 masters, 2,000-sq. ft., office, pool, garage, Country Club area, $369,000. Dennig, 575-921-1597.

WANTED

HOST INTERNATIONAL HIGH SCHOOL STUDENT, w/AFS. Hiebert-Dodd, 296-1158.

KIDS' OUTDOOR PLAY SET, w/swings. Chavez, 505-550-9722.

SMALL/MEDIUM DOG, well trained, for high-functioning autistic adult & older sister, warm loving home. Hughes, 296-8940.

Mileposts

New Mexico photos by Michelle Fleming
California photos by Randy Wong

Arlo Ames 35

Howard Royer 35

David Clements 30

Rose Gehrke 25

John Sullivan 25

Anita Dotson 20

Kristy Kaneshiro 20

Michael Morgan 20

David Osborn 20

Steve Pope 20

J.C. Powell 20

Rick Romero 20

Marissa Urioste 20

Steve Wimpy 20

Joe Bishop 15

Charles Carroll 15

Shelley Deaton 15

Rose Flores 15

Brian Hart 15

Diane Hollison 15

Josh Parsons 15

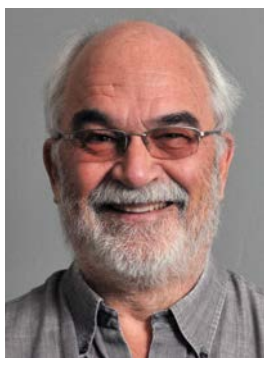
Rashad Raynor 15

Recent Retirees

New Mexico photos by Michelle Fleming
California photos by Randy Wong

Dan Wahl 35

David Marks 32 **Melinda Marks** 40



Mike Du Mond 25

NM Legislature honors Sandia serial innovators

Photo and Story by ***Mason J. Martinez***

Stan Atcitty and Hongyou Fan received recognition from the New Mexico Legislature recently for their distinguished achievements as serial innovators.

Rep. Abbas Akhil invited the Sandia pair to receive certificates of recognition on the floor of the House of Representatives and meet with Gov. Michelle Lujan Grisham.

Stan is a member of the Navajo Nation and was the first American Indian male to earn a doctorate in electrical and computer engineering from Virginia Tech University. He has won five R&D 100 awards, as well as the prestigious Presidential Early Career Award in 2012.

Hongyou, of the Advanced Materials Laboratory, is also a professor in the Chemical and Biological Engineering Department at the University of New Mexico. He has four R&D 100 awards and recently became the first researcher from a national lab to receive the Materials Research Society Mid-Career Research Award.

ROUNDHOUSE RECOGNITION — State legislators honored Sandia's Stan Atcitty and Hongyou Fan for their research. Posing at the Roundhouse are (left to right) Imre Gyuk, DOE program manager, Stan, Hongyou, and Babu Chalamala, manager, energy storage.

Fields of gold

FIELD STUDY — Sandia National Laboratories ecologist Jennifer Payne examines native vegetation planted to stabilize soil in an area following a construction project. Having an ecologist who specializes in restoration ensures Sandia upholds commitments to protect leased land. Payne is one of two Certified Ecological Restoration Practitioners in New Mexico, a title held by only 150 people in the country. **Photo by Randy Montoya**

Ecologist plans land makeovers, protects environment

By ***Manette Newbold Fisher***

On a drive around the Labs, ecologist Jennifer Payne sees more than wide-open desert, grasslands, cacti and dirt. She notices tiers of soil that have gone through stress, peers closely at the height and spacing of vegetation and recites the Latin names of native New Mexican plants and where they belong.

"No matter where I am, I'm always looking at the vegetation," Jennifer said. "It's like people who are into birding. Everywhere they are, they're looking at birds. Everywhere I am, I'm looking at vegetation."

Jennifer is a Sandia ecologist who stabilizes degraded lands. She is also one of two Certified Ecological Restoration Practitioners in New Mexico, a title held by only 150 people in the country. She was awarded the certification in 2017 by the Society for Ecological Restoration, an international organization of researchers, practitioners and leaders.

Having an ecologist who specializes in restoration ensures Sandia upholds commitments to protect land leased from Kirtland Air Force Base and land withdrawn from the U.S. Forest Service.

"At some point in time, some of that land may be turned back to either of those entities," said Sandia ecology team lead Steve Cox. "As opposed to having land with Russian thistle and tumbleweeds, we have an obligation to protect the land and return it to the way we got it."

Helping all species, furry arachnids included

Driving to a restoration project, Jennifer pulls over her truck, grabs a plastic cup and runs out to capture and move a tarantula from the road to a safe spot among native grasses. Sandia lands are home to lizards, snakes, birds and other wildlife that ecologists monitor and protect.

Even furry arachnids deserve help, according to Jennifer. "Reestablishing the natural habitat stabilizes the soil and benefits wildlife that quickly begin to use the area for cover, forage and breeding."

Sandia construction projects larger than an acre must have a Stormwater Pollution Prevention Plan and comply with a construction permit issued by the U.S. Environmental Protection Agency. Stormwater runoff from construction sites can cause significant erosion and degradation of local water bodies due to sedimentation, Jennifer said.

The EPA permits can't be terminated until 70% of the preexisting native vegetation cover has been reestablished across the project area, or the soil is stabilized with gravel.

Pouring seeds, not rocks

While complying with the permits is not unique to Sandia, the ecology team works to revegetate rather than just pour rocks.

Native vegetation looks better, is cooler in the summer and prevents unwanted weeds from overtaking the area, which can happen in unmaintained graveled areas, Jennifer said.

"I think gravel is commonly used on projects outside Sandia because reestablishing native vegetation requires specialized knowledge that not all construction companies have."

Native vegetation is incredibly resilient, and provides permanent soil stabilization without maintenance, she said. It can withstand weather extremes from droughts to intense monsoons, from frigid temperatures to heat waves. It's also better for animals.

"We've got a lot of land that is protected from urbanization and we've got a lot more wildlife than people realize," said John Kay, Sandia's stormwater program lead. "We're not in the business of creating a nature preserve, but in a way we kind of have one out here."

Blending in

Walking through a field at the base of the Manzano mountains, Jennifer stops to examine native grasses planted where heavy equipment was used to clean up large concrete structures. She created a reseeding plan for the area and now the new grass blends in.

At any given time, Jennifer works on multiple restoration plans and monitors sites that have been reseeded. She said John and his stormwater program will let her know when a project requires a stormwater permit in addition to reseeding.

Each site requires a slightly different methodology based on project constraints, microclimates, slopes and other project-specific factors, Jennifer said. Restoring degraded sites in central New Mexico is extremely challenging, with an average of just nine inches of precipitation a year, drying spring winds, hot summers and cold winters.

She provides her plans for each site to Sandia's facilities group, which hires subcontractors to reseed the area. Because she's not completing the hands-on reseeding, her plans must be extremely specific. John added that everyone involved is very thoughtful and careful in how Sandia completes revegetation.

"I think people would be surprised and impressed to know the lengths we go to protect the environment," John said.